28. A method for manufacturing a semiconductor device, comprising the steps of:

forming first grooves which respectively have vertical or substantially vertical walls in desired portions of a semiconductor substrate;

doping an impurity, whose conductivity type is opposite to said semiconductor substrate, in at least one of said first grooves to form a wiring layer;

depositing an insulating material to cover an entire surface of said semiconductor substrate including said first grooves to a thickness greater than half the width of the shortest side of the opening of said first grooves;

etching an insulating film of said insulating material to expose the surface of said semiconductor substrate and to leave said insulating material in said first grooves;

depositing an antioxidant film on the surface of said semiconductor substrate on which said insulating film is left;

forming a second groove, by selectively etching part of a surface of said antioxidant film between said first grooves; and

performing field oxidation using said antioxidant film as a mask to form an oxide film between said first grooves, said oxide film being formed integrally with said insulating film left in said first grooves.

29. The method according to claim 28, wherein said impurity is doped immediately after said second groove is formed.

30. The method according to claim 28, wherein said impurity is first doped after said first grooves are formed, and said imputity is secondly doped after said second groove is formed.

31. The method according to claim 28, wherein after said antioxidant film is deposited on the surface of said semiconductor substrate, part of said antioxidant film, and said semiconductor substrate between said first grooves are etched to form a second groove which has said insulating film left in said first grooves on at least part of a side surface thereof, and said field oxidation is performed using said antioxidant film as a mask.

32. The method according to claim 28, wherein after said first grooves are formed in said semiconductor substrate, or after said impurity is doped, an oxide film or a nitride film which does not block said first grooves is formed by oxidizing or nitrifying the entire surface of said semiconductor substrate or at least part of said first grooves.

33. The method according to claim 28, wherein after said insulating film is deposited on said semiconductor substrate which has said first grooves, a low-melting point insulating film is deposited on an entire surface or part of a surface of said insulating film and is melted, and said insulating film and said low-melting point insulating film are etched.

34. The method according to claim 28, wherein after said second groove which has said insulating film left in said first grooves on side surfaces of said second groove is formed by selectively etching part of said semiconductor substrate between said first grooves in which said insulating film is left, an antioxidant film is deposited to cover the entire surface of said semiconductor substrate and is etched, and said field oxidation is performed using said antioxidant film as a mask.

35. The method according to claim 28, wherein after said field oxidation is performed, part of a field oxide film is etched using said antioxidant film as a mask to obtain a flat structure.

36. The method according to claim 28, wherein an impurity whose conductivity type is the same as the conductivity type of said semiconductor substrate is doped in one of said first and second grooves to form a channel stopper and an impurity whose conductivity type is opposite to the conductivity type of said semiconductor substrate is dopoed in another of said first and second grooves to form a wiring layer.

37. The method according to claim 36, wherein immediately after said impurity whose conductivity type is opposite to the conductivity type of said semiconductor substrate is doped, said impurity whose conductivity type is the same as the conductivity type of said semiconductor substrate is doped.

38. The method according to claim 36, wherein before or after said first and second grooves are oxidized or nitrified so as not to block said first and second grooves, said impurity whose conductivity type is the same as the conductivity type of said semiconductor substrate is doped.

39. The method according to claim 28, wherein one part of said first and second grooves is shallower than a diffusion depth of an impurity region formed in said semiconductor substrate, and the other part of said first and second grooves is deeper than the diffusion depth of said impurity region, whereby said wiring layer which has a conductivity type opposite to the conductivity type of said semiconductor substrate and which is formed under said one part of said first and second grooves is electrically connected to a region of said impurity region, which has the same conductivity type as the conductivity type of said semiconductor substrate.

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